Water Management in the Upper Sub-Basin of the Inderagiri River Basin in Indonesia: Issues and Implications Related to Integrated Water Resources Management

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Abstract

Integrated water resources management (IWRM) is an important development agenda for addressing institutional problems and capacity building for the use, control, preservation and sustainability of water systems. Pursuing this requires understanding of related issues and their implications for development of effective water management institutions.

Indonesia is in the process of reforming its water resources management policy, which will give emphasis to putting IWRM principles into action. One of the elements of the new policy is related to the improvement of river-basin management. Although experience on river-basin management has been developed in one basin (Brantas river basin in East Java), this was not the case for other regions of the country until lately.

This paper discusses the dynamics of water use and management in the upper sub-basin of the Inderagiri river basin, in West Sumatra, Indonesia. Issues and implications related to IWRM are identified. The topics covered are:

- *the policy and institutional context of river-basin management, with an overview of the water management policy reforms and related aspects of policy relevant to improvement of river-basin management in West Sumatra Province;*
- *a more specific discussion on the setting and hydrology of the upper sub-basin;*
- *a special case illustrating water use competition and water allocation in a river (Ombilin River) within the upper sub-basin. This includes stakeholder identification; river water accounting; the changing pattern of water use; impacts on the poor and other downstream users; and the lack of a framework for river-basin management.*

The conclusion is that this problem of water-use competition and the impacts it causes have raised the need for improved water management in the Ombilin River. Frameworks for this are not yet developed. The on-going water management policy reform provides a basis for management improvement. It is suggested that measures be taken to review existing provincial water management regulations and to develop a framework for river-basin management. Capacity building for river-basin

management can be initiated from efforts to solve the Ombilin River problems, and lessons from the experience can be used for other river basins in West Sumatra.

1. Introduction

West Sumatra Province is one of the priority areas for improvement of water resources management, as part of the on-going implementation of policy reform. One item of the reform agenda is the improvement of river-basin management. River-basin management and water allocation from the source have increasingly become issues in West Sumatra in the last decade. The development of electric power plants and the growth of urban settlement areas in West Sumatra have increased demand for water, which in turn increased competition for water use between irrigated agriculture and other sectors of the economy.

Despite the increasing demand for better and more organised water management in West Sumatra, the framework and experience for river-basin management and water allocation from the source is not yet developed. This paper attempts to present issues related to river-basin management and to identify implications for efforts to adopt integrated water resource management principles as the basis for future development of effective institutions.

The paper first discusses the direction of water resource management reform in Indonesia. This is followed by a discussion of the upper Inderagiri sub-basin and its changing pattern of water uses. Two prominent issues related to water allocation and basin management are discussed, illustrating the nature and dynamics of water uses and management in the basin. In the last part implications related to integrated water resource management are identified.

2. The policy and institutional context of river-basin management in Indonesia

2.1 Water resources management policy reform

The Indonesian government is reforming its water resources and irrigation management policy. This section presents the reform principles, which are closely related to the improvement of river basin management, especially for the West Sumatra context. The reforms have four objectives (BAPPENAS, 2000):

1. Improving national institutional frameworks for water resources development and management.
2. Improving organisational and financial frameworks for river-basin management.
3. Improving regional water quality management, regulatory institutions and implementation.
4. Improving irrigation management policy, institutions and regulations.

Among those objectives, the first and the second are closely related to the improvement of water allocation from the source and river basin management. One of five sub-objectives[1] of the first objective mentions the involvement of stakeholders (including private sector) in river-basin management and decision-making. The proposed reforms in this sub-objective cover three areas:

- issuing government regulations emphasising the participation of stakeholders (public agency institutions, community, and private) in water resources development and management.

- amending ministerial regulations to: (1) include stakeholders' representatives in provincial and basin water management co-ordination committees (in Indonesian language called: PTPA and PPTPA); and (2) merging provincial water management committees (PTPA) with provincial irrigation committees.

- establishing functional PTPA and basin water management committees (PPTPA) with stakeholders' representation in key river basins in 12 provinces.

The second objective contains three sub-objectives, one of which is the improvement of the provincial regulatory framework for river basin and aquifers management. This will be the basis for development of effective water management institutions at province and basin levels.

2.2 River-basin management in Indonesia

River basins and their management authority. The Government of Indonesia (GOI) started to recognise the river basin as the unit of water management in 1982, through the enactment of Government Regulation (GR) No. 22/1982[2]. In 1989 Public Works Ministerial Regulation No. 39/PRT/1989 was issued to specify the 90 river basins in Indonesia[3]. The objective of this ministerial regulation is to ensure that conservation and use of water in the basins are conducted in a holistic and integrated manner. In 1990, the Public Works Ministerial Regulation (No. 48/PRT/

[1](1) Establishment a national water resources management co-ordination framework; (2) adoption of a national policy for water resources management; (3) involvement of stakeholders (including private sector) in river-basin management and decision-making; (4) improvement of national water resources information and decision support systems; (5) improvement of national hydrological and water-quality data collection and management systems.

[2]Article 4, Chapter III stressed the use of river basins as the basis for water resources management.

[3]The Public Works Ministry has been abolished this year and its function has been merged into the Ministry of Settlements and Regional Development (MSRD). This involved reorganisation of MSRD, whose name is changed to Ministry of Settlements and Regional Infrastructure Development. Adjustment of laws and regulations related to water management is underway within the framework of policy reform.

1990) was enacted, specifying the authority for the management of water and river basins. Out of the 90 river basins, 73 are managed by provincial governments, 15 fall under the management of Ministry of Public Works, and 2 basins[4] are under the management of public corporations. Incorporation of the idea of river-basin management into policy and action are thus relatively new to Indonesia and the management framework—other than in those two basins under public corporations—is not yet developed.

River basins of West Sumatra and the Inderagiri sub-basin. The area of West Sumatra province is divided into six river basins. These are named: Inderagiri; Silaut; Anai-Sialang; Rokan; Kampar; and Batang Hari. Two (Silaut and Anai-Sialang) are entirely in West Sumatra province, the rivers flowing down to the West Coast of West Sumatra. The other four are upstream parts of river basins, which flow to the East Coast of Sumatra in the provinces of Riau and Jambi. According to the Public Works Ministerial decision on the division of river basins, the Inderagiri river basin falls under the authority of the Ministry of Public Works because it is located in two provinces. The upper part is in West Sumatra and the lower part in Riau.

3. The upper sub-basin of Inderagiri river basin and its hydrology

3.1 Demographic and employment features

The population of the sub-basin in 1997 was 662,425, and the average population density was 408 persons per km^2. The urban-rural population ratio was 0.28. This implies that water supply for urban needs will be an important issue in the near future. In terms of households, the population data show that in 1997 there were 150,466 households in the basin. The average household size was 4.59 persons. It is estimated that only about 12.56 percent (or some 18,898) households were served by pipe-borne water. These data reflect there are still a large number of households that need piped water in the future. There were also some industries, offices, and other social facilities that were served by piped water.

About 67.6 percent were categorised as farm households[5], indicating that the majority of households in the basin engaged in the agricultural sector as their main occupation. It is reasonable to expect water demand for agricultural-related activities to be a major issue in the basin.

[4]Brantas River in East Java under the Jasa Tirta Public Corporation, and Citarum River in West Java under Otorita Jatiluhur Public Corporation.

[5]Data taken from agricultural census conducted in 1993. No recent data available on the number of households by type of livelihood or occupation. Data from 1993 agricultural census were used to estimate the number of households in agricultural and non-agricultural sectors. Assuming that the percentages of people in both sectors are as before, the number of farm households in the basin in 1997 would be 97,742.

3.2 The sub-basin

The sub-basin consists of three major rivers, Lembang/Sumani, Sumpur, and Ombilin, and two lakes, Danau Dibawah and Singkarak. Water from the Lembang/Sumani and Sumpur rivers flows into Singkarak Lake, while the Ombilin River originates from Singkarak Lake and flows eastward to the Inderagiri. The altitude varies from 164 m above sea level at the lowest point (near confluence of Ombilin River and Sinamar River) to 1,200 m at the highest point where the Lembang River originates from the Dibawah Lake. Thus, water supply in the Ombilin River depends largely on the outflow from Singkarak Lake, while Singkarak water supply is influenced by inflow from Lembang/Sumani and Sumpur rivers. Moreover, water supply in Lembang/Sumani River is largely determined by the outflow from Danau Dibawah Lake. These three main rivers (and their tributaries) and two lakes constitute a sub-basin.

The total area of the upper Inderagiri sub-basin is estimated at 3,059.7 km^2. The Lembang/Sumani watershed constitutes 48 percent of this, the Ombilin 30 percent, and the Sumpur 13 percent. The sub-basin includes 400 villages, within three districts and three municipalities. Around 87 percent of the villages are rural.

3.3 Climate and rainfall

The sub-basin generally has the typical humid tropic climate that covers almost all of Sumatra. However, differences exist among regions of the basin. An agro-climatic map of West Sumatra (Oldemann[6] et al 1978) shows five climatic zones—on the basis of consecutive wet and dry months[7]—in the basin. Based on these zones, a large part of area of the sub-basin under Lembang/Sumani and Sumpur Rivers belongs to the wettest zone, while most of the Ombilin watershed is in the driest zone, constituting around one-third of the sub-basin. Consequently, changes in the outflows from Singkarak Lake would affect water availability for the part of the sub-basin in the Ombilin watershed.

Rainfall in the basin tends to follow the agro-climatic zones. Average annual rainfall in the sub-basin is 2,025.9 mm. There are differences in rainfall pattern between the watersheds. The data show that the watershed of the Sumpur River is wettest, with average rainfall of 2,484 mm per year. This is slightly higher than the Lembang/Sumani watershed (2,200.6 mm). The Ombilin watershed is driest (1,789.3 mm).

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[6]Climatic zone Type A has 9 consecutive wet months and less than 2 consecutive dry months; Type B1 7–9 consecutive wet months and less than 2 consecutive dry months; Type C1 5 –6 consecutive wet months and less than 2 consecutive dry months; Type D2 3 –4 consecutive wet months and 2–3 consecutive dry months; Type E2 less than 3 consecutive wet months and 2–3 consecutive dry months.

[7]Oldemann et.al. (1978) defined a wet month as having monthly average rainfall of 200 mm or more, and a dry month as having 100 mm and less.

4. The sub-basin under stress: construction of hydroelectric power plant at Singkarak Lake and impacts on the poor and other water users on Ombilin River

4.1 Stakeholder identification and water accounting[8] along Ombilin River

Stakeholder identification. Four major groups[9] from various sectors have direct interests in the water of the Ombilin River. These are farmers/irrigators who use waterwheels to lift water from the river; a coal-mining company which uses water for washing coal; domestic water suppliers who provide water for Sawah Lunto town and their consumers; and an electricity company which uses water from Singkarak Lake for hydro-power generation (for which the outflows from the lake to Ombilin River need to be reduced) and for two thermal power plants located along the river[10].

The hydrological setting. (See Figure 1 for schematic presentation). Seven major rivers flow into the Ombilin River and influence its discharge. They are (from upstream to downstream): Bengkawas, Katialo, Silaki, Selo, Malakutan, Lunto, and Lasi. Among these, the Selo has the biggest inflow to the Ombilin, and Silaki the lowest (see Figure 2).

Zoning of the sub-basin and water uses. Based on types of water uses, the Ombilin River can be divided into three zones: A (upstream), B (midstream), and C (downstream).

Zone A is from the Singkarak outlet to the confluence with Selo River. In this zone the use of water is mainly for irrigation. Water is lifted by waterwheels. Three rivers, Bengkawas, Katialo, and Silaki, flow into the Ombilin in this zone. 58 waterwheels were found, of which only 30 were functioning.

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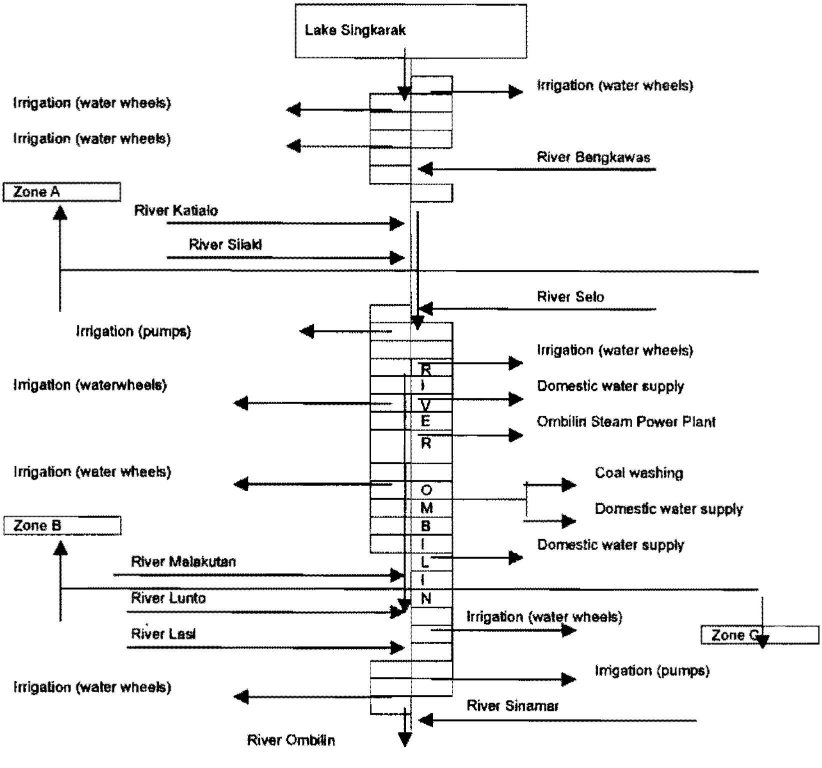
[8]Water accounting is an art and procedure "to classify water-balance components into water use categories that reflect the consequences of human intervention in the hydrologic cycle" (Molden, 1997). This classification enables analysis of water uses, depletion, and productivity in a water basin context. There are three main components: inflow (consisting of gross inflow and net inflow), available water (the difference between net inflow and committed water), and committed water (the part of outflow reserved for other uses). The depletive use consists of two components: process and non-process depletion.

Increasing competition for water from the river source creates conflicts among users. Efforts to improve water management at a particular river require understanding of how much water is available, being used, and depleted for various uses, and for this water accounting is a tool to generate understanding, which will help in formulating policy and developing effective institutions.

[9]Other groups do not consume water but use the river for various activities. They include fisherfolk; users of river for bathing, washing, and other personal needs; people collecting building materials such as sand, gravel, and stone.

[10]For more details of impacts on the poor and other users see section 4.3.

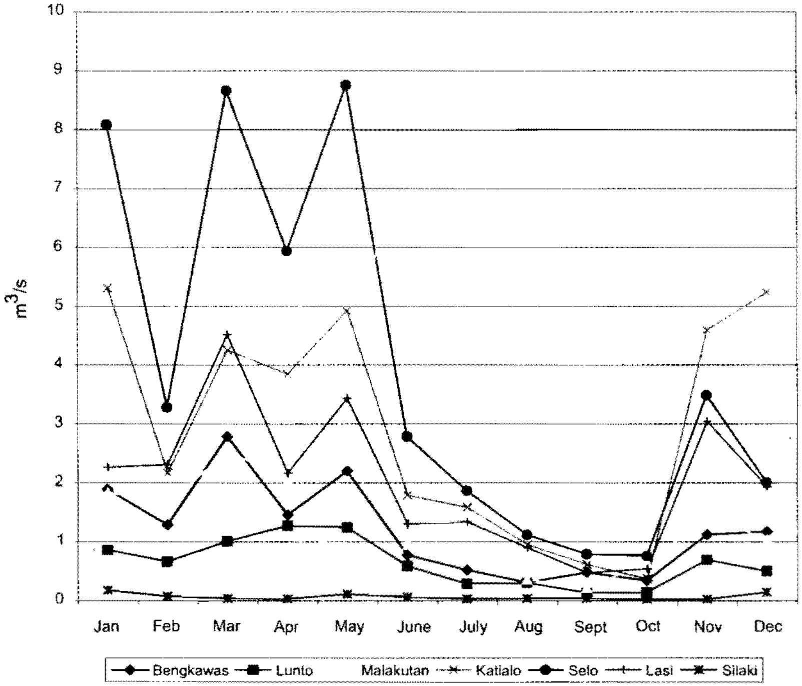
Figure 1: Inflows, water uses, and zoning of part of the Ombilin River (under study)



Zone B is between the confluences with the Selo and Malakutan rivers. There are three types of water use in this zone: irrigation, domestic, and industrial. From the inventory, 77 waterwheels for irrigation are found only 38 of them functional. In addition to the waterwheels, five pumping stations for irrigation are also in this zone. There are two pumping stations for drinking water and one for washing coal.

Zone C is between the confluences with the Lunto and Sinamar rivers. In this zone water use is mainly for irrigation, using waterwheels to lift water from the river. In this zone there are 231 waterwheels for irrigation, of which only 116 are functioning. In addition, there are nine pumping stations for irrigation.

Figure 2: Dependable flows of seven tributaries flowing into the Ombilin River



4.2 Water Balance

Water balance computations for each zone showed that discharges are higher than the outflows for water uses for different purposes (Table 1). In Zones A, B and C, respectively only about 5.4 percent, 30.6 percent and 12.7 percent of the water is being used. The data suggest that pressure on water resources is highest in Zone B, followed by Zone C, and Zone A.

Water Accounting. Further classification of the water balance components into use categories (river water accounting) indicated that the depleted fraction of gross and net inflow for the part of the Ombilin River under study is 0.34 (in this case gross inflow is equal to net inflow). The process fraction of depleted water is 1 (because total depletion is assumed to be equal to process depletion), and the process fraction of available water is 0.43. (Table 2).

Table 1: Water balance computation for the Ombilin River

Items	Zone A		Zone B		Zone C		water flowing downstream
	Inflow m^3/s	Outflow m^3/s	Inflow m^3/s	Outflow m^3/s	Inflow m^3/s	Outflow m^3/s	
Singkarak Lake	3.333	-					
Bengkawas River	1.19	-					
Katialo River	2.97	-					
Silaki River	0.07	-					
Irrigation (Agric.)	-	0.41					
Water Balance	7.563	0.41	7.153				
Selo River			3.96				
Irrigation (Agric.)			-	0.92			
Talawi Domestic WS Company			-	0.04			
PLN Thermal Power Plant			-	0.005			
TBO Thermal Power Plant			-	1.9			
Coal washing			-	0.14			
Rantih Pump Station (Domestic WS)			-	0.4			
Water Balance			11.113	3.405	7.708		
Malakutan River					1.32	-	
Lunto River					0.64	-	
Lasi River					2.02	-	
Irrigation (Agric.)					-	1.489	
Water Balance					11.688	1.489	10.199

4.3 Issue 1: Impacts of construction of a hydro-electric power plant at Singkarak Lake on the poor and other water users.

The development of Singkarak Hydro-electric Power Plant has caused a drastic reduction in the discharge of the Ombilin River because a large amount of water from Singkarak Lake is now drained out to another river, flowing to the west coast, whereas the Ombilin River flows to the east coast. A permanent weir has been built at the outlet from Singkarak Lake to the Ombilin River, and the outflow to the river has been reduced and kept in the range of 2–6 m^3/s instead of the former average of about 40 m^3/s. The development of Singkarak HEPP has thus increased the scarcity of water, and competition over water use in the river.

Changing the amount of water supply has brought about a number of changes in the water use pattern of the basin. It has also brought several problems to water users along the river.

Table 2: Water accounting for part of the Ombilin River under study (normal year)

No	Items		Note	Amount	Total
	Inflow				
1	Gross inflow		2+3+4+5+6+7+8+9		15.503
2		Singkarak Outlet	m^3/s	3.33	
	Zone A	Inflow from rivers			
3		a. Bengkawas River	m^3/s	1.19	
4		b. Katialo River	m^3/s	2.97	
5		c. Silaki River	m^3/s	0.07	
	Zone B	Inflow from rivers			
6		Selo River	m^3/s	3.96	
	Zone C	Inflow from rivers			
7		a. Malakutan River	m^3/s	1.32	
8		b. Lunto River	m^3/s	0.64	
9		c. Lasi River	m^3/s	2.02	
10	Storage Change		11 + 12		0
11	Surface			0	
12	Subsurface			0	
13	Net inflow		1 – 10		15.503
14	Depletive use				
15	Process depletion		17+18+19+21+22+23+24+25		5.304
16	Evapotranspiration				
17	Zone A Irrigation (Agric.)		m^3/s	0.410	
18	Zone B Irrigation (Agric.)		m^3/s	0.920	
19	Zone C Irrigation (Agric.)		m^3/s	1.489	
20	Municipal, Industry, and Energy.		21+22+23+24+25		2.485
21	Talawi Domestic WS Company		m^3/s	0.040	
22	Coal Washing		m^3/s	0.140	
23	Rantih Pump Station (Domestic WS)		m^3/s	0.400	
24	PLN Thermal Power Plant		m^3/s	0.005	
25	TBO Thermal Power Plant		m^3/s	1.9	
26	Non-Process depletion				0
27	Flows to sinks		m^3/s	na	
28	Other evaporation		m^3/s	na	
29	Total Depletion		15		5.304
	Outflow				
30	Total Outflow		13 – 29		10.199
31	Surface outflow from rivers		30	10.199	
32	Surface outflow from drains			na	
33	Subsurface outflow			na	
34	Committed Water		35+36		3.1
35	Navigation (assumed)		m^3/s	0.775	
36	Environment maintenance (assumed)		m^3/s	2.325	
37	Uncommitted water		30 – 34	7.099	
38	Available water		13 – 34	12.403	
39	Available for irrigation		38 – 20	9.918	
	Indicators				
40	Depleted fraction (gross and net)		37 / 13 x 100 %	34 %	
41	Process fraction (depleted)		15 / 29	1	
42	Process fraction (available)		29 / 38 x 100 %	43 %	

(1) Reduction in the number of waterwheels and irrigated area

Irrigation systems along the Ombilin River are supplied by traditional waterwheels and pumps. No surface system was found. This method of irrigation is felt by the farmers to be the most suitable system under the physical conditions. The limited rice fields available; their locations scattered over a narrow flat area along the river; and the average river width of around 50 meters would make the construction of weirs for surface irrigation very costly. In addition, the porosity of the soil requires continuous flows of irrigation.

A field inventory found some 184 waterwheels serving a command area of 333 hectares and 463 farmers. This indicates that, on average, a waterwheel serves 1.8 hectare with 2.5 farmers involved. However, the exact capacity of waterwheels as well as serviced area and number of farmers involved vary depending on the size of waterwheel which is determined by the length, number, and diameter of its water tubes.[11] In general, the capacity of a waterwheel increases as the length, number, and diameter of water tubes increase. In reality, there are waterwheels that could irrigate up to 15 hectares, involving some 30 farmers.

Pump irrigation technology has begun to be used in the last few years, especially by those whose land can no longer be served by waterwheels. When the field inventory was conducted 14 pump irrigation units were found along the Ombilin River, with a command area of 138.5 ha, involving some 200 farmers. Most of these were provided by either government or non-government agencies. Pumps are usually given to farmers who group themselves into an organisation. In that case, pump irrigation is owned by a group and not by a farmer personally. There has thus been a change in the institutional form of irrigation ownership, following change in the irrigation technology from traditional waterwheel to pump irrigation system.

Some farmers whose land was served by pump irrigation complained about the cost of operation and maintenance of a pump compared to a waterwheel. Another problem is the soil type, which is mostly porous and needs continuous inflow of water to maintain soil moisture and fulfil the crop water requirement. This is a weakness of pump irrigation whose technology often is not mastered by the farmers and whose operating time is limited. A waterwheel on the other hand has a comparative advantage, as it can be operated continuously without significant additional cost.

Irrigation has been severely affected by reduction in the river discharge. The numbers of waterwheels, command area, and farm families serviced have declined markedly after the Singkarak HEPP development. The number of currently existing waterwheels is only around 50 percent of that in 1996 (before the operation of the Singkarak HEPP started), and current irrigated area is approximately 61 percent of that in 1996. Table 3 shows changes in these numbers during the last five years.

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[11]A water tube is part of the waterwheel, extracting water from the river. Normally, the larger the waterwheel the higher the number of tubes it has. However, under some conditions—for example, when river discharge is low— the operator may reduce the number of tubes to allow it to continue operating.

Table 3: Number of waterwheels, service area, and farmers in the Ombilin River from 1996–2000

Year	Number of waterwheels	Irrigation service area (ha)	Number of farmers
1996	366	549	729
1997	296	470	621
1998	237	405	556
1999	195	343	478
2000	184	333	463

(2) Increased operation and maintenance costs of waterwheel irrigation systems

For owners and operators of waterwheels, reduction in the river discharge has caused several problems in system operation and maintenance (O&M). Firstly, the current discharge, especially in the dry season, often cannot rotate the waterwheels or if it can the rotation rate is very low. Consequently, operators have to lengthen the traditional weir to increase water depth and direct water towards the wheel so as to increase its rotation speed. Another way of making a waterwheel continue operating under such conditions is by reducing the number of water tubes, making it lighter and easier to move. The consequence of both choices is increase in the workload and cost of operating and maintaining the system, and reduction in the capacity of the wheel to supply water which means decrease in the area of land irrigated and reliability of irrigation water.

Secondly, increased intensity of damage on traditional weirs and waterwheels results from drastic increases of river discharge due to sudden opening of the gate at the Singkarak outlet. According to farmers, the gatekeeper usually opens it during the rainy season to avoid flooding on the settlement and irrigated area, which are located in low land surrounding Singkarak Lake. Consequently, Ombilin River discharge increased during the rainy season because of additional inflow coming from Singkarak Lake.

To the owners and operators of waterwheel irrigation systems, increased damage intensity means more labour, capital and costs if the system is to be repaired. The socio-economic survey shows that on average the intensity of waterwheel damage increased from 1 to 2.5 per season since the operation of Singkarak HEPP (Table 4)

(3) Unreliability of irrigation water and decline of rice yield.

The higher intensity of damage to waterwheels has resulted in some problems in irrigation water supply. Most farmers reported that irrigation water supply has been unreliable since development of Singkarak HEPP, due to the above-mentioned problems of operation and maintenance. As a result, the growth and yield of rice on land irrigated by waterwheels declined markedly. Some farmers reported a lighter effect while others noted a considerable decline. The socio-economic survey showed that the average yield of rice dropped from 4.2 ton per hectare before the development of Singkarak HEPP to 3.1 t/ha in 1999.

Table 4: Damage intensity, and average rehabilitation costs of waterwhseels and weirs, before and after development of Singkarak HEPP

Items	Average intensity/cost (per season)		Percentage increase
	Before HEPP Rp.	After HEPP Rp.	
Waterwheel damage	1	2.5	150
Weir damage	1	4.5	350
Rehabilitation costs of waterwheel	150,000	1,100,000	633
Rehabilitation costs of weir	50,000	425,000	750

(4) Impact on domestic water supply and industry

The reduction of discharge in Ombilin River has also affected the water supply of the pump station for coal washing and the water quality of domestic water supply. However, the coal washing company experienced it only initially. The PLN (the company operating the Singkarak HEPP) has built a weir to improve water level so that problem is solved.

Reduced water quality has brought some problems to domestic water suppliers and consumers. The main problems facing the domestic water suppliers (in this case was PDAM) is increased operation and maintenance costs. The domestic water company manager estimated that water treatment cost increased by almost 100 percent. However, at times when raw water quality was very low, the domestic water suppliers did not perform water treatment since it would not bear any improvement in the quality of water. At such times, the domestic water company would distribute raw water directly to the customers without treating it. So far, no health-related problems caused by low water quality have been reported by the domestic water consumers.

The latest data show that in 1999 the company served approximately around 27 percent (or 15,042) people of Sawahlunto municipality. This indicates that a low percentage of people have access to pipe-borne water in the town. Therefore, it is reasonable enough to expect a growing demand for piped water in the near future, and a greater amount of water from Ombilin river to be taken by PDAM since there are no other water sources in the area.

4.4 Issue 2: Non-existence of organisation for river-basin management and framework for water rights licensing.

As has been mentioned earlier, the incorporation of the idea of river-basin management into policy and action are relatively new to Indonesia. The management framework is not yet developed except in two basins in Java, which are managed by publicly owned corporations. In other provinces, the idea of river-basin management is newly introduced. As the responsibility for water management is fragmented among a number of government agencies a provincial water management committee (PTPA) is supposed to be set up in each province[12]. In West Sumatra the PTPA was set up in 1994. The characteristics of this committee are:

- Its main function is to assist the governor in co-ordinating water management at the provincial level.
- The specific tasks are: (1) data collection, processing, and preparing materials to be used to formulate provincial policy on water management co-ordination; and (2) providing consideration and/or advice to the governor on matters related to water supply, waste water drainage, and flood control.
- The members of the committee are staff from agencies related to water management (other stakeholders are not considered as members of the committee).

No specific budget was allocated for this committee, so its activity was on an ad hoc basis. When there were problems related to water supply, drainage or flood a meeting of provincial staff would be held but it was not clear whether the meeting was a PTPA meeting or just a meeting related to the performance of general government tasks.

The government regulation related to the provincial PTPA has an article, which states that the governor can set up basin water management committees (PPTPA) to assist the PTPA in performing its tasks. Until now no such committee has been set up in any of the six river basins in West Sumatra. As conflicts over water allocation and use tended to increase in West Sumatra, as illustrated with the case of Ombilin River, there is clearly a need to develop a framework for river-basin management in the province. The case of Ombilin River can be used as the pilot activity to develop the framework and capacity for integrated water resource management at the basin level.

In terms of priority of water use, GR No. 22/1982 underlines that water for drinking is the highest priority because drinking water is a very basic human need for survival. This essential need of water for human life seems to be the basis for prioritisation so that the order of priority can be seen, as one source said, as water for life, water for livelihood, and water for amenity. Environmental need for water is not included in the list. Since there are inter-regional differences in water use and in the capacity to provide water, the order of priority below drinking water may be arranged differently in different regions of Indonesia. The PTPA is the co-ordinating body tasked with making such prioritisation.

The prioritisation still leaves questions, such as how it would be applied in decision making in times of short- or long-term water shortage. What about the

[12]Based on Public Works Ministerial Decision No. 67/PRT/1993

irrigation systems, if higher priority users exert their right over water from the same source? Clarification of such points remains desirable.

Water rights are to be given in the form of use rights, allocated by the government through a licensing mechanism. Since water and source of water are considered to embody social functions, there are uses of water that require licence, and others do not. Tapping sources for non-commercial drinking water and other individual domestic uses is allowed without licence as long as these do not harm the water source or other water users' interests. According to MR No. 48/PRT/1990, a government licence is required for uses like domestic water supply, municipality and real estate, irrigation, animal husbandry, plantation, fishery, industry, mining, energy, navigation, disposing of waste, etc.

The Minister of Public Works or the governor is authorised to issue licences for water use within their respective basins. Licences for groundwater use are issued by the Minister of Mining and Energy. Licences for water use may be given to individuals, groups of individuals or any legal entity. A group having a licence is authorised to arrange water distribution among its members based on government regulations. Those granted a licence must pay a fee to the ministry or to the governor, depending on who issues the licence. According to MR 48/PRT/1990, the fee is to be used for financing operation and maintenance of water structures and maintaining of the water source. Every licence on water use has a time frame depending on the kind of use. There is no general reference for this yet, but the fee is supposed to be set every five years.

Transfer of water licences is prohibited. Article 18 of MR 48/PRT/1990 states that giving up a water licence or selling it to other parties may be allowed if the licensing agency gives its permission. The MR, however, is not explicit on this exception.

This formal system for allocating water use rights is hardly implemented, except perhaps to some extent in the two basins managed by publicly owned company. The problems are not only the existence of gaps and inconsistencies in the formal regulations, policies and organisations. The lack of consensus on some key concepts (Pusposutardjo 1996) and the lack of hydrological data in most of the basins (Hehanusa et al. 1994) make it impossible for the government to make basin-level plans or even to make the right decisions on whether or not new uses of river water are justifiable.

Regulations provide that licences for water uses that potentially affect water balance must be based on general basin-level plans for development, protection, and utilisation of the basin water. In cases where such plans have not been made, the issuing of licences must be based on consensus in the co-ordinating body, PTPA. But what would be the basis for such a consensus?

In most basins, water allocation is governed by whatever local communities accept as rules. In predominantly agricultural basins, traditional adat may govern water allocation. Where non-agricultural sectors have exerted their interests, claims over water may be based on political or economic power leading to transfer of water from the agricultural sector (Kurnia et al 1996). Nevertheless, government is capable of exercising the authority in water allocation, including inter-basin water transfers.

Transferring water from Ombilin River to Anai-Sialang basin is an example. The decisions about this transfer, it seems, were made on the basis of studies done by the government. The original water users must adjust to the new situation.

One of the impacts of the government action, for farmers in Ombilin River, is that it has affected the operation of their waterwheels supplying water to their paddy fields, due to lower river discharge. The lower flow has also caused domestic pollution more felt in the downstream Ombilin River. This underlines the importance of formalisation of irrigation water rights in order to protect the interests of the poor and small farmers. Also, it is important to assess the technologies used by the existing water users in order to predict the impact of river water reallocation and consequent reduced water supply to them.

5. Conclusions and implications for Integrated Water Resources Management

Preceding sections have indicated the need to develop effective water management institutions. Improving water management in Inderagiri sub-basin (especially in the under watershed) will take more effort and longer time because the organisation for river-basin management and frameworks for water rights are not yet developed.

The construction of a hydroelectric power plant at Singkarak Lake has significantly reduced the outflow from this lake to the Ombilin River, which in turn has affected water users along the river. Among the impacts were:

- the cost of operating waterwheels has increased and the number of waterwheels for irrigation has gone down by around 20 percent;
- reported productivity of irrigated rice has decreased; and
- water quality for domestic water supply has declined and the cost of water purification has increased.

A number of options can be considered in order to solve the problems in the short term, while starting longer-term efforts to develop effective water management institutions. The proposed options are:

- In the short-term, problems faced by the users need to be solved by reviewing water allocation rules, especially by releasing more water from Singkarak Lake to Ombilin River.
- The handling of water allocation needs to be done systematically. A water board consisting of all stakeholders should be set up and given authority to regulate water allocation, especially from Singkarak Lake.
- The technology for lifting water for irrigation both with waterwheels and diesel pumps needs to be adjusted to meet the need of local environment. Soil porosity is high and there is need for 24 hours of water supply. The waterwheel is well suited for this environment but the water level in the river is not sufficient to continue operating it

efficiently with the current technology. Farmers indicated that they have difficulties with the cost of pump operation and maintenance and are thinking about using electric pumps to lift water from the river.

- It is also proposed that the electricity company provide a special discount for the domestic water supply company and farmers who will use electric pumps for irrigation, as a "good neighbourhood policy."

- In the long-term, the government should take the initiative to set up a co-ordinating body (water board) which can effectively enforce water allocation rules, for which the national water resources policy has provided a legal basis.

Steps required to implement these options would include:

- Reviewing all water-related laws and provincial regulations and adjusting these in accordance with the direction of the new national water policy.

- Drafting and issuing a Governor Decision for setting up a working group to review water-related laws and regulations, and a co-ordinating and/or operating body for river (sub-)basin management, using the Ombilin sub-basin as the pilot site.

- Reviewing the possibility of charging a surface water use tax, and using this income to finance the co-ordinating body and river and watershed maintenance.

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